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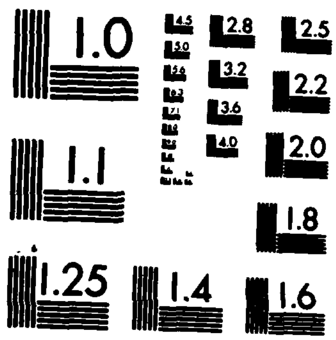

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AMSAA

MAJOR ASSEMBLIES STOCKAGE MODEL

INVENTORY
RESEARCH
OFFICE

Arthur Hutchison

January 1984

US Army Inventory Research Office
US Army Materiel Systems Analysis Activity
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The Major Assemblies Model is a Multi-Echelon, Asymmetric Stockage Model which determines component/part stockages in a two echelon logistics system to achieve a given weapon system target operational availability at least cost. This model, along with a Data Base Management System, has been programmed on an IBM Personal Computer and evaluated in USAREUR for the V Corps and VII Corps' Major Assembly Direct Exchange (DX) inventory system.

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MAJOR ASSEMBLIES STOCKAGE MODEL

Chapter 1. INTRODUCTION

1.1 Model Overview.

The Major Assemblies Model is a multi-item, two echelon model. It determines, by means of mathematical optimization techniques, how many of each component to stock at all units within a two echelon environment. The stockage levels are calculated by determining the potential impact of each item backordered on weapon system downtime. The final stockage quantities are determined by the level of weapon system operational availability that is to be achieved.

1.2 Current Application.

This model has been developed to compute stockage for major assemblies in USAREUR (US Army Europe) at the corps and division levels. However there are no mathematical nor operating procedures that would prevent using the model in other logistic structures.

1.3 Implementation on the IBM Personal Computer.

This model has been programmed on an IBM Personal Computer (PC) to facilitate the development and evaluation of the stockage procedures. Even though the IBM PC has proven to be adequate to run the model in USAREUR, we do not necessarily recommend its use as the standard system. The program on the IBM PC consists of a data base management system as well as the stockage model.

1.4 Model Evaluation.

This model is an adaptation of the SESAME model developed by this office for use by the DARCOM Major Subordinate Commands in computing budget estimates for initial provisioning. Extensive testing has been done by this office and other organizations to determine the effectiveness of the model in computing stockage levels to meet desired target availability rates. The evaluation done for this model, in this case, consisted of comparing current stockage levels in USAREUR to those recommended by the model for a limited number of items.

Chapter 2. USAREUR LOGISTICS STRUCTURE

2.1 Organizational Structure.

The responsibility for management of major assemblies is vested in the Corps Materiel Management Center (MMC). The MMC determines corps stockage levels and approves levels submitted by the divisional and non-divisional units.

The corps operates a Corps Exchange Point (CEP) which stocks major assemblies in support of the various Direct Support (DS) customers. The V Corps operates one CEP and the VII Corps operates four. Currently the VII Corps is reevaluating the desirability of this structure and may revert to one CEP with several geographically located storage sites. In this report, the CEP is sometimes referred to as a General Support (GS) unit.

The customers of the CEP are the divisional and non-divisional maintenance units in the corps. There are approximately 19 DS customers in the V Corps and 11 in the VII Corps.

2.2 Item Profile.

There are approximately 350 items managed under the major assemblies system in both the V and VII Corps. All of these items can be classified as Line Replaceable Units (LRU), whose failures will down the weapon system. Most of the items are reparable electronic or tank automotive lines. Most of the items are repaired at the GS level, others at theater depots, and the remainder at CONUS depot activities.

2.3 Current Policy.

Major Assemblies are managed under a direct exchange (DX) procedure. An unserviceable must be turned in to the CEP in order to receive a serviceable replacement at the DS unit. The CEP is also resupplied in the same manner. An unserviceable must be turned in to the Theater activity responsible for the item before a serviceable can be issued.

Currently the stockage policy for these items at the DS and CEP is somewhat ambiguous. In general, however, the stockage policy in AR 710-2 for DX items is applicable to these items. One exception is the stockage levels at the CEP for items repaired at Mainz Army Depot. For these items, 30 days of supply is stocked at the CEP.

UNIT F9T	PART 1220 01 0217287
UNIT PRICE	9330.00
REPAIR TIME (DAYS)	9
REMOVALS GARRISON /YEAR	10
REMOVALS EXERCISE /DAY	0
PERCENT REPAIRED /YEAR	.75
PERCENT WASHOUT /YEAR	0
ORDER SHIP TIME	25
SOURCE OF SUPPLY	1H

Figure 1. Part Record

UNIT IDENTIFICATION CODE	BM9
DS/GS/TH	DS
DENSITY	144

Figure 2. Unit Record

MTBF (DAYS)	78.2
MTR (DAYS)	3.304
USAGE RATE/YEAR	0

Figure 3. Weapon System Record

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Chapter 3. DATA BASE REQUIREMENTS

3.1 Data Base Management.

A Date Base Management system has been programmed on the IBM PC to enable the user to easily enter and edit the data required by the stockage model. The data base consists of three types of records: part,unit,and weapon system. The data required for these records does not differ significantly from data required to compute stockage lists under current policy.

3.2 Parts Records.

A part record must be created for each unit that requisitions, repairs, or stores a particular part (figure 1) . This enables each unit to have unique part characteristics reflected in the data base.

Below are the data requirements for the part card.

Unit Identification- Identify the unit requisitioning, repairing, and/or storing the item. This five digit code can be the DODAC (Department of Defense activity code),the UIC (unit identification code),or the common nomenclature (eg. C/708).

Part Identification- This 15 digit code can be the national stock number, part number, or the part nomenclature.

Unit Price - The price of the part obtained from the Army Master Data File.

Repair Time - This is the time in days required to repair the item at the unit identified on the part card. If the part is not being repaired at the unit a zero is entered.

Removals - The number of part removals from the weapon system experienced in one year. Removal occurring in major exercises (eg REFORGER) should not be included in this figure.

Removals/Exercise - This field is not currently used in the model.

Percent Repaired	- If the unit repairs the item, the percentage of removals at this unit that are repaired is entered. If no repair occurs at the unit, enter a zero. For second echelon units, this number represents the percentage of removals at the GS unit and unserviceables received from DS units that are repaired.
Percent Washout	- This is the percentage of items that are considered beyond repair and therefore not passed to the next higher source of supply for repair. For major assemblies in USAREUR, this number is always zero since the items can be disposed of only by the depots.
Order Ship Time	- This is the time in days required to submit a requisition on the source of supply and receive the part. Under the DX system this represents the time required to pass the unserviceable to the source of supply and receive the serviceable part at the requisitioning unit.
Source of Supply	- This is the identification code for the unit's supplier of the particular part. This entry must be consistent with the identification used on the unit cards and part cards. The source of supply for the top echelon, whether it is a theater activity or CONUS, is identified as "TH".

3.3 Unit Records.

A unit record must be created for all units referenced on the part cards (figure 2). In addition, there must be a unit named "TH" to represent the source of supply for the top echelon units.

Below are the data requirements for the unit record.

Unit Identification -This element must correspond to the entries used on the part cards.

DS/GS/Theater -The unit must be identified as a first echelon unit (DS), second echelon unit (GS), or theater (TH). The theater unit represents the source of supply for all second echelon units.

Density -This is the number of a particular weapon system supported by the unit. Usually only DS units have a density figure. If float items are maintained by the Corps, only then would the GS unit have weapon system density.

3.4 Weapon System Record.

The model computes stockage for one weapon system's parts at a time. The data in this record (fiqure 3) are necessary to calculate the operational availability expected with a given stockage list. These data are not used to compute the actual stockage quantities.

MTBF -(Mean Time Between Failures) This is the reliability measure for the weapon system. It represents the average number of days between failures that will down the end item. The figure is obtained from the MRSA (Materiel Readiness Support Activity) Equipment Readiness report.

MTR -(Mean Time to Repair) This is the average time in days to return a weapon system to an operational status once a component failure occurs. This data element is also obtained from the MRSA Readiness Report.

Usage Rate/Year - Currently this field is not used.

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Chapter 4. MODEL MATHEMATICS

4.1 Overview.

Two inventory models are used to compute the quantities to be stocked at each unit in the two echelon logistics structure. The first model is the symmetric computation, the second asymmetric. The primary reason for this approach is to reduce computer run times.

In the symmetric model, the removals, OST's, percent repaired and washouts, and the repair times are averaged across all units by echelon. The resulting structure is an average one echelon unit and an average two echelon unit. Then the model computes an average stockage quantity for the one echelon unit and an average quantity for the two echelon unit. These quantities are then passed to the asymmetric model.

The asymmetric model uses the exact logistic structure as entered in the data base. The average quantities from the symmetric model are used as a starting stockage quantity for the asymmetric optimization procedures. This procedure involves searching for the optimal stockage quantity by one unit at a time until the appropriate stockage quantity is found.

4.2 Symmetric Model Mathematics.

A detailed description of the mathematics of this model can be found in references (2) and (7).

$$\text{Minimize} \sum_{ij} \text{Stock}(i,j) \times N(j) \times \text{Unit Price}(i)$$

$$\text{Subject to: Pnors} < \text{Alpha}$$

where

Stock (i,j)	= quantity of item i stocked at echelon j unit
N(j)	= number of units at echelon j stocking item i
Unit Price(i)	= unit price of item i
Pnors	= percent of time the system is down due to the unavailability of an item
Alpha	= maximum permissible percent system down time

The constraint on weapon unavailability can be included in the objective function by rewriting the problem as:

$$\begin{aligned}\text{Minimize} \sum_{ij} & \text{stock}(i,j) \times n(j) \times \text{unit price}(i) \\ & + \text{expected backorders}(i,j) \times \text{rtd}(i,j) \times n(j) \\ & \times \text{backorder penalty cost}(i)\end{aligned}$$

where

Expected Backorder(i,j) = number of item i backordered at unit j

rtd(i,j) = percent of item i replaced at echelon j. For the majority of items in USAREUR the items are all replaced at the first echelon (e.g. rtd(i,1) = 100%

4.3 Determining Expected Backorders.

Backorders are determined at each echelon for every item. Backorders depend on the unit's demand rate, stockage level, and extended pipeline. This pipeline is determined by the order ship time plus repair time, if any, at the unit plus the time delay to the customer if the next higher echelon is out of stock. This time delay is arrived at by computing the expected backorders at the top echelon for a given stockage level. No expected delay due to backorders at the second echelon is computed in this model. The major assemblies model assumes a Poisson distribution in computing backorders at each echelon.

4.4 Backorder Penalty Cost.

To solve the equation in 4.2, a cost must be incurred whenever an item is backordered. However, this is not an explicit cost but rather a variable cost dependent on the level of system operational availability desired. When running the model, an initial backorder cost is chosen (lambda=10), an optimal stockage list is produced, and the system operational availability is computed. If the operational availability does not meet the target to be achieved the backorder cost is increased and the model is re-run. By increasing the backorder cost, more stock is required to minimize the cost equation. The process of increasing the backorder cost continues until the operational availability target is met.

4.5 System Operational Availability (OA).

Once an optimal stockage list is found for a given backorder cost the system operational availability is computed. This is accomplished by first computing the average logistics delay time (LDT) at the first echelon due to a backordered item. Since all of the items will down the weapon system, the expected backorders for each item multiplied by the time required to fill the backorder will represent the total time the system is down due to the non-availability of the item.

The LDT is combined with information on the frequency of failures for the weapon system and average time to repair the weapon system to arrive at the calculated operational availability. This formula is:

OA= MTBF / MTBF + MTR + LDT

where

MTBF= Mean time between failures (an input value)

MTR = Mean time to repair (an input value)

LDT = Logistics delay time

4.6 <u>Optimization Technique.</u>

The following discussion of the Major Assemblies Model optimization technique follows the flowchart in figure 4.

To start the model, the user must first input the target Operational Readiness to be achieved. In many cases, a target of 100 percent is entered in order to find the maximum OA target achievable. The backorder cost or Lambda value is set initially to 10.

The optimization routine operates on one item at a time until the entire data base is read. First the pipeline quantities for the GS and DS are calculated using:

$$\begin{aligned}\text{GS Pipe} = {} & \text{Rem}(2) \times \text{Prep}(2) \times \text{Rct}(2) + \\ & \text{Rem}(2) \times (1-\text{Prep}(2)) \times \text{Ost}(2) + \\ & \text{Rem}(1) \times (1-\text{Prep}(1)) \times \text{Worg} \times \text{Ost}(2) \times \text{Orgper} + \\ & \text{Rem}(1) \times (1-\text{Prep}(1)) \times (1-\text{Worg}) \times \text{Prep}(2) \times \text{Rct}(2) + \\ & \text{Rem}(1) \times (1-\text{Prep}(1)) \times (1-\text{Worg}) \times (1-\text{Prep}(2) \times \text{Ost}(2)\end{aligned}$$

where

Rem(i) = Quantity removed at echelon i

Prep(i) = Percent repaired at echelon i

Rct(i) = Repair Cycle Time at echelon i

Ost(i) = Order ship time at echelon i

Orgper = Average number of first echelon units per second echelon unit

Worg = Percentage of washouts at echelon one

The first element of the GS pipe is for removals at the second echelon repaired at the second echelon; the second, for removals at the second echelon not repaired; the third, for removals at the first echelon that are washouts and not available for repair; the third for one echelon removals repaired at the second echelon; and the last for one echelon removals passed to the second echelon but not repaired there.

The DS pipe is calculated using:

$$\begin{aligned}\text{DS Pipe} = {} & \text{Removes}(1) \times (1-\text{Prep}(1)) \times \text{Ost}(1) + \\ & \text{Removes}(1) \times (\text{Prep}(1)) \times \text{Rct}(1)\end{aligned}$$

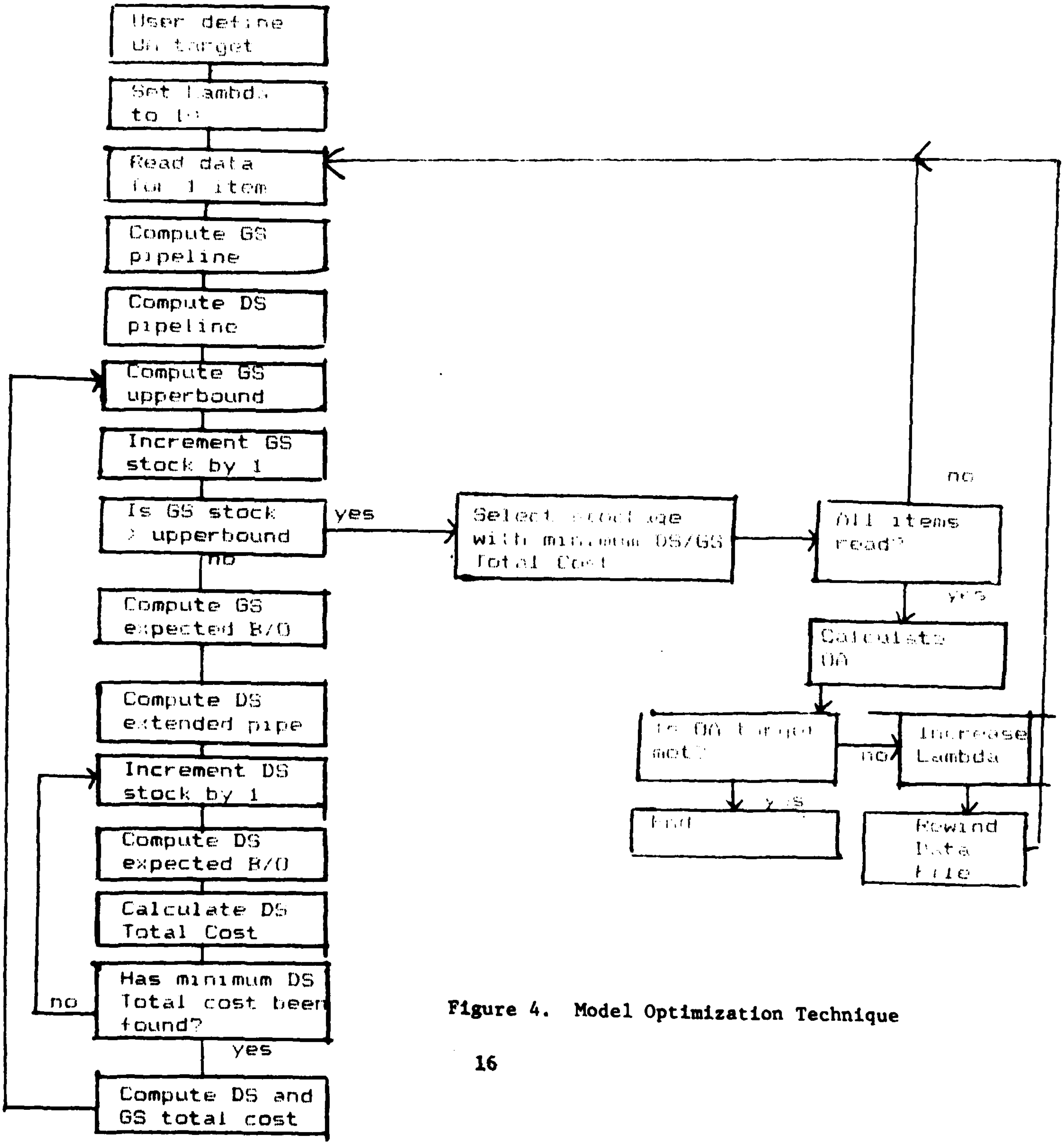


Figure 4. Model Optimization Technique

The first element of the DS pipe is for removals at the first echelon that are not repaired and therefore passed to the second echelon; the second, for removals at the first echelon repaired at the first echelon.

Optimizing the total cost function for the first echelon is rather simple because the function is convex. However, this is not true for the second echelon optimization procedure. Kruse (7) describes a procedure for setting an upper bound on GS stock so that only a finite number of searches is needed to find the optimal GS stock. To increase the efficiency of the search routine, a new upper bound for GS stock can be computed each time an optimal value for DS stockage is found for a given GS level.

The search procedure begins by trying stockage levels at the GS from zero to the upper bound. For each value, the expected backorders at the GS level are computed assuming a Poisson distribution. Now we can calculate the expected delay the DS customer will experience for a given GS stockage level. This value is added to the DS pipeline to give an extended pipeline. This extended pipeline represents the time required to resupply the DS when the GS has stock plus the DS resupply when the GS is out of stock.

With the GS stock fixed, the routine proceeds to find the optimal stockage for the DS level using the fact that the DS *total cost function* is convex. Stockage quantities from zero up are placed at the DS level, and the expected backorders are calculated along with the total cost function. Once the optimal total cost is found, the search is complete for an optimal DS stock given the GS level of stockage.

The total cost for GS and DS is calculated, and the program returns to the GS level and increments the GS stock by one. The procedure is then repeated until the GS stock reaches the upper bound. The optimal stockage positions for the DS and GS are found by selecting the stockage posture that gives a minimum total cost value for GS and DS. This procedure is repeated until all items are read in the data base.

Once all items have been read, the expected operational availability is computed for the weapon system. This formula is shown in Section 4.5. The logistics delay time is the average (weighted by demand) over all items of the expected DS backorders divided by the associated demand rates. If this OA does not meet the target set by the user , the backorder cost or lambda is increased by a factor of 10 and the process starts over again.

When the target is met, the process is complete and the stockage lists are printed.

4.7 Asymmetric Model.

The mathematics underlying the stockage calculations for a symmetric system could, in principle, be simply extended to asymmetric support structures. However, computational experience indicates that the computer time required to explicitly and optimally calculate stockage levels becomes excessive as the number of different locations increases. Therefore, a heuristic was developed to obtain near optimal solutions with much less computational effort.

The first step is to run the symmetric process as described above. The resulting stockage levels from the symmetric model become the input to the asymmetric heuristic.

The heuristic allocates the total second echelon stockage among the actual asymmetric second echelon units using a marginal allocation algorithm (reference 1). This represents the starting values of stock at each second echelon unit. For these starting values of stock, optimal DS stock is calculated as in the symmetric process. At each step in the heuristic, DS stockage is such that given the second echelon stockage levels, DS stockage achieves the OA target at least cost.

For each second echelon unit, the heuristic now searches around the starting value of second echelon stock. Second echelon stock is increased in increments of one, the corresponding (optimal) DS stock is calculated, and the total cost is compared against the solution for the previous value of second echelon cost. If an improvement is found, second echelon stock is again incremented by one, corresponding DS stock is calculated, and the total cost calculated and compared against the previous value. The heuristic continues in this manner until the solution does not improve by increasing stock at that second echelon unit. The last solution obtained is stored as the incumbent solution.

The heuristic now returns to the original starting value of second echelon stock obtained from the symmetric solution and successively decreases second echelon stock from this value until no improvement in the total cost equation is obtained by decreasing second echelon stock by one more unit. The solution, so obtained, is compared with the incumbent solution, and the better of the two is retained as the heuristic solution.

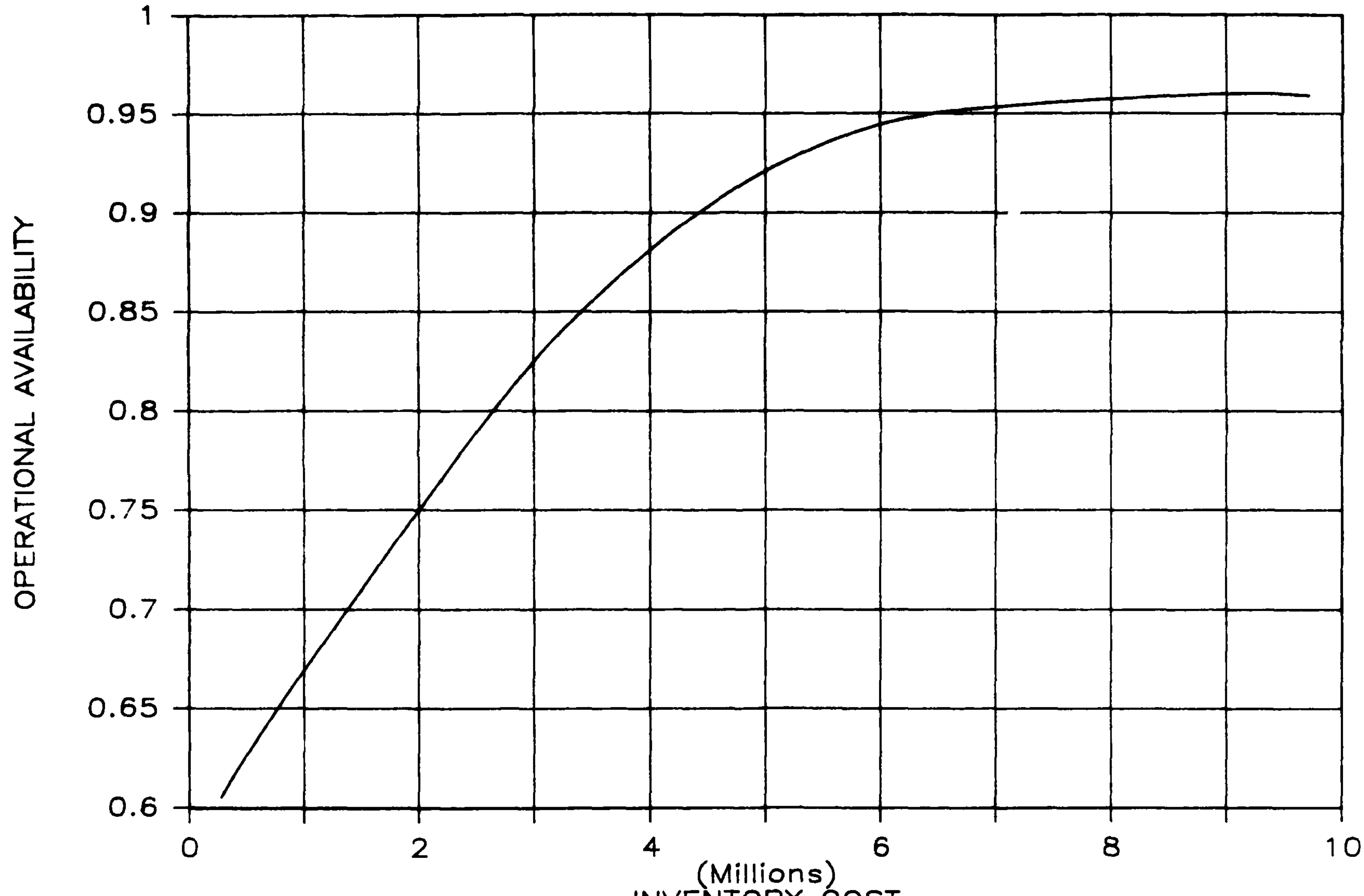
This search technique finds a local minimum in the area of the starting symmetric solution. Of course, this may not yield the true global solution but computational experience (reference 5) shows that solutions within one-half to one percent of optimal are obtained with this heuristic. The resulting run times are conservatively estimated as five to ten times faster than an exact asymmetric algorithm.

4.8 <u>Operational Availability vs Inventory Cost Graph.</u>

A graph of operational availability versus total inventory is shown in figure 5. For each lambda value run in the above process, the OA and cost are plotted (represented by the circles). Each of these points represents a complete and optimal stockage list. The user can select any point and print out the associated stockage list. This graph is also useful in determining where the "knee of the curve" lies. This is the point where additional investment in inventory does not result in substantial improvement in weapon system operational availability.

Table 5.

V CORPS STOCKAGE FOR M60A3



Chapter 5. EVALUATION

5.1 Areas Evaluated.

Currently, IRO does not plan to run simulations or field test this model. Statistical evaluations of the multi-echelon model have been made by this office and other activities during the development of SESAME and other implemented versions of this model. Also,the Concepts Analysis Agency and the Logistics Evaluation Agency have on-going projects to "evaluate" this model and other retail level models currently in use or under development.

In our evaluation of this system, we looked at four areas: the availability and accuracy of the data; a subjective evaluation of the stockage levels produced by the model; the ease of use and understanding of the process by the "user"; and the potential for further enhancements of the model when specific needs are identified by the user.

5.2 Availability and Accuracy of the Data.

The Major Assemblies Model relies on accurate data to reflect the local logistics structure where the model is used. Also, it was important to USAREUR that the data required by the model be easily obtained by the MMC's with little reliance on the division level elements to provide data. Both of the stipulations were met fairly successfully.

There is little in the way of automated data collection procedures in USAREUR for the major assembly DX lines. However, most of the data required by the model are routinely collected by the Corps Exchange Points and the Corps Materiel Management Center in hard copy form. Improvements can be made, however, in the collection of the following data elements: Division order ship times; repair cycle times; mean time between failures and mean time to repair.

Division order ship time data were estimated for this work by sampling DX turn-in documents at the CEP. The date recorded by the divisions when the turn-document was initiated was the starting point for OST. The receipt and fill date recorded by the CEP was the halfway point. The difference in these two times was multiplied by two to arrive at the complete order ship time cycle. Computed times ranged from 7 days for most electronic items to 14 days on tank-automotive parts for units in "remote areas". The paperwork required to accurately measure this time by item and unit is available; it only needs to be routinely collected and the required

information tabulated. Order Ship Times between the CEP and Theater activities were automatically collected under a new management program initiated by the 200 Th Theater Materiel Management Center.

Data on repair cycle times, like division OST times, were collected by sampling completed DA form 2407's, Maintenance Request forms. The time between the receipt of the unserviceable at the maintenance shop and the completion of repair represent the repair cycle time. As in the case of the OST documentation, these data were not routinely collected and tabulated.

Data on weapon system Mean Time Between Failure and Mean Time to Repair was collected from the MRSA Readiness Report. However, these data are not available on all weapon systems. This does not prevent running the stockage model for these systems, but the level of inventory cannot be expressed in terms of projected weapon system Operational Availability.

5.3 Validity of Results.

One advantage realized by using the IBM personal computer is the ability of the local command to judge the impact of using the Major Assembly Model prior to actual implementation. The data can be inputted into the model and results obtained without disrupting current ADP systems or operations. Then analysis can be performed to determine the impact of changing inventory policies.

Our original intentions were to provide a comparison of the current stockage profile in USAREUR and that produced by the model. This comparison would only show changes in inventory investment,not supply performance. We were not able to complete this comparison, however, because USAREUR was not able to give us a complete picture of the asset positions for Major Assemblies in the divisions. The section deals with the data we were able to collect. One should be cautioned in attempting to extrapolate these data completely to the entire collection of major assemblies stocked in USAREUR.

5.3.1 Stockage List for VII Corps M561 and M113 Items.

Only the VII Corps was able to provide us with stockage levels on the two systems run under the Major Assemblies Model. These data were collected at the Corps Materiel Management Center. We were advised that the levels recorded by the MMC were not validated by the divisions and there was some degree of uncertainty about the accuracy of the numbers.

The level of inventory investment (where we set the lambda value) chosen for the Major Assemblies Model was the "knee of the curve". This

is the point on the cost versus operational availability curve where additional dollar investment does not result in significant increases in OA. The resulting stockage list was then compared to the current RO and the DX policy in AR 710.2.

The stockage levels for the 710.2 DX policy are:

Repair Cycle Level = (ADD x PREP) x RCT x 1.25

Operating Level = $\sqrt{(2 \times AYD \times (1-PREP) \times OC) / (HC \times UP)}$

Order Ship Time = (ADD x (1-PREP) x OST)

Safety Level = (ADD x (1-PREP) x 15)

where

ADD	= Average Daily Demand
AYD	= Average Yearly Demand
RCT	= Repair Cycle Time (days)
PREP	= Percent Repaired at the Unit
OC	= Ordering Cost
HC	= Holding Cost
UP	= Unit Price

5.3.2 Stockage List Analysis.

The data for this analysis can be found in figures 6 and 7. The most prominent feature that can be observed in comparing the major assemblies stockage list and those of the EOQ policy and the reported RO's is the reduction in stock at the GS levels. The GS levels stock only to replenish the divisions' inventory where the divisions stock to prevent weapon system down time due to the unavailability of the major assembly. Therefore, the GS can carry less stock. This feature of the major assembly model was considered desirable by the material managers in the two Corps' MMCs.

At the division level, the total stock computed under the Major Assemblies Model is greater than that required by the EOQ model. This is due to the number of units with "low" demands for these items. For low demand items, the Major Assemblies Model will stock more units in order to protect against backorders. For an item with a monthly demand of one, the model might stock three times this demand rate to achieve a desired level of protection. Another item with a monthly demand of 20 might be stocked only at one and one-half of the monthly demand and still achieve the same level of protection as the low demand item.

When looking at total corps stock, notice that the stockage quantites for the EOQ and the Major Assemblies model are similar. In general the excess stock at the GS level has been pushed forward in order to provide greater protection against backorders that cause weapon system downtimes.

The RO's reported by the divisions are generally too high. This could be attributed to the reliance on "human" judgement of what stockage quantities should be maintained and the difficulty for the divisions in collecting data and manually computing stockage lists according to policy. Another problem seen by the divisions is the erratic availability of assets from the corps. This can be attributed to the great variability in resupply time from CONUS. A quick and dirty analysis of these ship times shows the resupply times for one item can range from 30 days to one year. Therefore, the divisions protect themselves by requesting "excessive" stock. It should be noted, however, that very few RO's were filled with on-hand and on-order stocks.

5.4 Using the IBM PC Major Assemblies Model.

The use of the IBM PC proved to be most beneficial in the development and evaluation of the model. More importantly, the personal computer allows direct interaction between the materiel manager and the various components of the stockage system. The user has visibility and control of the data base, the use of the model, and the final determination of levels of inventory. For example, if the manager does not want to target the inventory to weapons system OA but instead to a dollar constraint, he is able to do this easily. Another run might be made to constrain the list to the approximate on-hand inventory position. In general, the material manager can view different stockage positions based on various local decisions that need to be made.

The operation of the model was easily learned by the noncomputer personnel in the MMC's. Since the programs are completely menu driven, no prior computer experience is necessary. Should this model be implemented in the Army there should be no need for additional MOS skills. Instead this model and computer system should be viewed as an additional tool available for use by the material manager.

5.5 Enhancement to the Model.

Currently, we feel there is further work that can be done to provide additional capabilities in the Major Assemblies Model system. Such enhancements could be: extending the model to compute three echelon stockage requirements; constraining stockage lists according to mobility requirements; computing

combat stocks; and using the model in other than a DX Major Assemblies environment.

If this basic model is in use and the data bases are complete and accurate, then the process of developing and evaluating these enhancements is simplified. Developmental work in these areas can be accomplished at IRO using "live" data from the field. Once the initial research is complete, the changes can be taken to the field, tested, and a dialogue be established between the user and IRO to evaluate the effectiveness of the changes. Making permanent changes to the retail programs involves only replacing the floppy discs.

TABLE 1. VII Corps M561

Major Assemblies Model / 710-2 EOQ Model / Reported RO

UNIT	ENGINE	XMISN	R. DIFF	TRANSFER	F. DIFF	C. DIFF
CEP 1	9/15/14	7/12/19	2/3/6	7/11/12	1/3/12	5/7/10
CEP 2	11/19/30	9/17/26	1/3/8	9/16/44	2/4/5	1/1/0
CEP 3	6/11/0	1/3/0	1/1/0	1/1/0	1/1/0	1/1/0
CEP 4	4/9/0	9/15/0	1/3/0	4/5/0	2/3/0	2/4/0
DS 1	9/7/32	8/6/22	3/2/8	7/3/14	5/3/6	6/4/11
DS 2	15/13/20	12/10/15	4/3/5	9/7/16	5/3/5	0/0/0
FWD DS 1	4/3/4	5/3/5	2/1/1	3/1/2	2/1/1	2/1/2
NON-DIV DS 1	2/1/4	4/2/2	0/0/0	4/3/0	0/0/0	0/0/0
NON-DIV DS 2	3/3/8	4/3/4	1/1/1	2/1/4	0/0/0	1/1/3
NON-DIV DS 3	2/1/8	2/1/6	0/0/0	3/1/6	0/0/0	3/1/5
NON-DIV DS 4	9/7/6	3/1/2	0/0/0	7/6/3	0/0/0	0/0/0
CIV LABOR DS	6/3/6	8/6/4	3/1/2	4/3/4	3/1/2	4/1/2
CIV LABOR DS	6/3/0	8/6/0	3/1/0	4/3/0	3/1/0	3/1/0
GS TOTAL	30/54/44	26/57/45	5/10/14	21/33/56	6/11/17	9/13/10
DS TOTAL	56/41/88	54/38/60	16/9/17	43/28/49	18/9/14	19/9/23
TOTALS	86/95/132	80/95/95	21/19/31	64/61/105	24/20/31	28/21/33

1. The first 4 units (CEP 1-4) are the four CEP storage sites in VII Corps
2. Units labeled DS 1 and DS 2 are the combined Division Main and Division Forward units in the two full divisions in the VII Corps
3. FWD DS 1 is the divisional unit for the forward division in VII Corps
4. Units labeled Non-div DS are individual DS units supporting non divisional units.
5. The last two units are Civilian Labor Groups performing DS level maintenance

TABLE 2 VII Corps M113

Major Assemblies Model / 710-2 EOQ Model / Reported RO

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UNIT	ENGINE	XMISN	F.DRIVE	DIFF	TRANF
CEP 1	13/20/52	9/15/52	9/17/33	8/13/11	8/12/8
CEP 2	28/47/72	25/44/48	14/28/23	8/15/18	15/27/23
CEP 3	7/12/26	7/11/9	5/9/12	5/7/2	2/2/12
CEP 4	6/10/0	6/11/4	3/5/0	2/3/0	2/3/0
DS 1	16/13/62	13/9/56	11/7/51	11/7/19	10/7/8
DS 2	31/31/57	30/28/35	22/20/13	14/10/15	22/18/22
FWD DS 1	12/7/15	10/6/11	10/7/14	4/1/1	2/1/5
NON-DIV DS 1	2/1/16	2/1/6	9/7/13	5/3/4	5/3/6
NON-DIV DS 2	3/1/4	3/1/6	3/1/3	3/1/3	3/1/2
NON-DIV DS 3	2/1/8	4/1/5	4/1/4	3/1/4	2/1/5
NON-DIV DS 4	4/3/3	5/3/2	3/1/1	2/1/1	2/1/0
CIV LABOR GP	8/5/6	8/3/4	6/4/3	4/1/2	4/1/2
CIV LABOR GP	8/4/0	8/3/7	6/4/0	3/1/0	4/1/0
GS TOTAL	54/89/150	47/81/113	31/59/68	23/38/31	27/44/43
DS TOTAL	86/66/161	83/55/132	74/52/102	49/26/49	54/34/50
TOTALS	140/155/311	130/136/245	105/111/170	72/64/80	81/78/93

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